

SECOND SUPPLEMENT

to

DESIGN MEMORANDUM

on

WELLS HARBOR, MAINE

13 August 1965

U. S. Army Engineer Division, New England

Corps of Engineers

Waltham, Massachusetts

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD

WALTHAM, MASS. 02154

ADDRESS REPLY TO:  
DIVISION ENGINEER

REFER TO FILE NO. NEDED-R

13 August 1965

SUBJECT: Second Supplement to Design Memorandum for  
Wells Harbor, Maine

TO: Chief of Engineers  
ATTN: ENGCW-E

1. In accordance with EM 1110-2-1150, Engineering and Design, Definite Project Studies, and in particular Paragraphs 6a and 20a thereof, there are inclosed five copies of the Second Supplement to the Design Memorandum for Wells Harbor, Maine. Sufficient data from the original design memorandum and the first supplement thereto are included in this second supplement to make it complete without need for reference to those earlier documents.

2. Although informal discussions have been held with local officials, formal contact has not yet been made with the State and Town to obtain concurrence in the proposed work and supplemental assurances of local cooperation. Upon approval of the Design Memorandum, this contact will immediately be made. It is requested that a high priority be given to the review of the Design Memorandum. Presuming favorable action on the Design Memorandum and by State and local officials on extended assurances, it is proposed to award a contract for the jetty extensions in September, to enable construction of as much of the jetty extension as possible before possible suspension of work in the mid-winter period.

Incl  
as

R. R. PLOGER  
Brigadier General, USA  
Division Engineer

U. S. ARMY ENGINEER DIVISION. NEW ENGLAND  
CORPS OF ENGINEERS  
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SECOND SUPPLEMENT TO DESIGN  
MEMORANDUM ON WELLS HARBOR, MAINE

1. Pertinent Data Estimated Cost  
(Incl. Conting. & Gov't Costs)

a. Proposed work

- |   |                 |
|---|-----------------|
| 1. Extension of 2 jetties at harbor mouth about 1200 ft. each, to 10 ft. contour      | \$592, 000      |
| 2. Dredging of settling basin in harbor, upriver of anchorage (in lieu of tidal dike) | 54, 000         |
| 3. Redredging original project  | <u>232, 000</u> |
|   | \$878, 000      |

b. Proposed Work Schedule and Funding

	<u>Construction Schedule</u>	<u>Funding<sup>(1)</sup></u>	
		<u>FY 1966</u>	<u>FY 1967</u>
1. Jetties	Oct - Dec 1965 <sup>(4)</sup> May - Sep 1966	\$370, 000	\$222, 000
2. Dredging Settling Basin	Jun '66	54, 000	
3. Redredging original project	Jun '66-Aug '66	<u>76, 000</u>	<u>156, 000<sup>(2)</sup></u>
		\$500, 000	\$378, 000 <sup>(3)</sup>

(1) All funds are maintenance funds except \$66, 000 construction funds to finish original project channel.

(2) Incl. \$66, 000. Balance construction funds in NED 6/30/65.

(3) Requires \$312, 000 maintenance appropriation for FY 1967.

(4) Assume Jan - Apr 1966 Suspension for winter period.

c. Design Elevations

1. Design tide	+12 ft. m. l. w.
2. Design wave	
At jetty head	14 feet
At jetty trunk	10 feet
3. Jetty Dimensions	
Top elevation	+16 ft. m. l. w.
Top width	12 feet
Slopes	
At head	1 on 2
At trunk	1 on 1.5
4. Entrance channel	
Width	100 feet
Depth	
To point where shore arms	
of jetties connect to parallel	
channel jetties	8 feet
Inner entrance channel and	
inner harbor	6 feet
5. Anchorage Basin	
Area	7.4 acres
Depth	6 feet
6. Settling Basin	
Area	300 feet x 450 feet
Depth	10 feet

PROJECT AUTHORIZATION

2. The Design Memorandum for the navigation improvement at Wells Harbor, Maine was submitted 18 August 1961. The project plan described in the Design Memorandum and recommended for construction was the same as that authorized by the River and Harbor Act of 14 July 1960 and described in the authorizing document, HD 202/86/1. The project authorized in 1960 is a modification of an existing project. The modification authorized in 1960 provides for:

a. the construction of two converging jetties (north jetty - 640 feet, south jetty - 940 feet) at the entrance to the harbor to promote scour in the entrance channel and also to impound littoral drift;

b. an entrance channel, 8 feet deep, 100 feet wide, running in a northwesterly direction from deep water to the constriction between the tip of Wells Beach on the south and Drakes Island on the north; and

c. a channel 100 feet wide and a 7.4 acre anchorage, 6 feet deep, behind the spit of land that forms Wells Beach.

By 1st Indorsement 20 September 1961, OCE requested additional information concerning stone sizes for the jetties and impounding life of the jetties based on the littoral drift. The requested data was furnished by 2d Indorsement 29 September 1961. The estimated project cost (1960) was \$572,000 exclusive of preauthorization study costs of \$8,000 and aids to navigation costs of \$1,000. Local interests were required to contribute 37 percent of this cost or \$212,000. In addition, other non-Federal costs were estimated at \$36,000, including \$5,000 for lowering of a submarine water line, \$26,000 for a public landing, and \$5,000 for spoil area dikes.

3. The project was authorized subject to the conditions that local interests agree to:

a. Contribute in cash 37 percent of the cost of construction, said contribution then estimated at \$212,000.

b. Provide, without cost to the United States, all lands, easements, rights-of-way, and suitable spoil disposal areas necessary for the construction and subsequent maintenance when and as required;

c. Hold and save the United States free from damages due to the construction and maintenance of the project;

d. Provide and maintain at local expense necessary mooring facilities and utilities, including a public landing with suitable supply facilities, open to all on equal terms;

e. Construct and maintain any bulkheads required for retention of dredged material from the initial construction and subsequent maintenance; and

f. Accomplish and maintain without expense to the United States alterations as required in sewer, water supply, drainage, and other facilities.

The Town of Wells authorized a \$250,000 bond issue, 11 March 1961. The Maine Legislature approved an appropriation to the Town of Wells of \$100,000, which the Town added to the total funds applied to this project.

instead of reimbursing their own treasury. The Town has planned a marina development with the major part of this \$100,000. The Town of Wells and the State of Maine executed the assurances of local cooperation, and the Town acquired and provided a large disposal area for dredged material, and contributed \$5,000, the estimated cost of diking. The Town also entered into contracts for construction of two public landings and development of terminal areas for anticipated boat use, one on the harbor side of the tip of Wells Beach, and a much larger one on the mainland shore of the harbor adjacent to the inner harbor.

4. Investigations and Project History. - The jetty design was believed to be adequate to impound the annual net littoral drift over the project life, estimated at 2,100 cubic yards per year. The jetties were designed as follows:

	North Jetty	South Jetty
Mean range of tide		8.7 feet
Length of jetties	640 feet	940 feet
Top elev. Inshore ends	+17 mlw(200 ft)	+16 mlw (300 ft)
Outer ends		+13 mlw
Top Width - Trunk		5 feet
Outer ends		7 feet
Side slopes		1 vert. on 1.5 hor.
Cover Stone		
Outer end		
Ground elev. 0 to +3 MLW		3-5 T
Inner end		
Ground elev. Above +2 MLW		2-3 T
Core Stone		Quarry Run

5. The project cost estimates presented in the Design Memorandum are as follows:

#### 1960 Cost Estimate

Channels - Dredging 234,000 c. y.	\$310,000
Ordinary material @ \$1.32/c. y.	
Contingency allowance	47,000
Breakwaters - Jetty Construction	
17,500 T stone @ \$7.72/T	135,000
Contingency Allowance	20,000

Preauthorization studies	8, 000
Engineering and Design	13, 000
Supervision and Administration	47, 000
Total Cost	<u>\$580, 000</u>

#### Comparison of Cost Estimates

	Document Estimate (1958)	Latest Approved Estimate (1960)
Channels - Dredging	\$337, 000*	\$310, 000
Contingencies	-	47, 000
Breakwaters - Jetties	151, 000*	135, 000
Contingencies	-	20, 000
Preauthorization Studies	8, 000	8, 000
Engineering & Design	14, 000	13, 000
Supervision and Administration	<u>38, 000</u>	<u>47, 000</u>
	\$548, 000	\$580, 000

\*Includes contingencies

The increase in cost of \$32, 000 is primarily due to increase price levels.

#### Allocation of Costs:

	Document Estimate (1958)	Latest Approved Estimate (1960)
Federal ( C of E ) Cost	\$348, 000	\$368, 000
Non-Federal Costs		
Cash Contribution	200, 000	212, 000
Other Costs		
Lower water pipeline	5, 000	5, 000
Public Landing	25, 000	26, 000
Dikes	<u>15, 000</u>	<u>5, 000*</u>
Total Non-Federal Cost	\$245, 000	\$248, 000

\*Decrease based on building causeway across marshland to public landing.  
Use of existing marsh materials for dikes would reduce cost materially.

## Annual Costs

Interest & Amortization	
\$586,000 <sup>(1)</sup> at 2.5%	\$20,700
Maintenance	
Dredging 4,000 c. y.	6,000
Jetties 175 T	1,800
Aids to Navigation	100
	<u>\$28,600</u>

(1) Inc. \$8,000 preauthorization study costs, \$1,000 aids to Navigation, and \$5,000 non-Federal cost of lowering water line. Other non-Federal costs considered self-liquidating.

6. The benefits resulting from the project, as presented in the authorizing document and slightly modified in the Design Memorandum, were estimated as follows:

a. <u>Source of Benefit</u>	<u>Document Amount</u>	<u>Current Amount</u>
Recreational craft transferred from other harbors	\$ 700	\$ 1,070
New recreational craft, locally based	14,500	20,280
Transient recreational craft	1,800	2,530
Lobster fishing boats	8,260	8,700
Shore protection	1,000	1,500
Land enhancement	1,250	0
Totals	<u>\$27,580</u>	<u>\$34,080</u>

The benefit cost-ratios on the above bases are as follows:

	B/C
Authorizing Document	1.0
Design Memorandum	1.2

7. The 1st Supplement to the Design Memorandum was submitted on 21 September 1962 and requested modification of the project plan as follows:

(a) From the tip of Wells Beach, a stone revetment around 680 feet of the tip of the point and a dumped riprap wave absorber 100 feet long along the inner end of the channel side of the south jetty;

(b) Extension of the north jetty a minimum of 100 feet; and

(c) Construction of a groin 400 feet long at Drakes Island.

8. These modifications were necessitated by rapid erosion of the tip of Wells Beach and subsequent shoaling of the inner channel and anchorage, and also to reduce wave attack on the tip by absorbing wave energy reflected along the smooth channel face of the south jetty. The extension of the north jetty, and the proposed groin at Drakes Island, were recommended to prevent sand from drifting into the harbor entrance from Drakes Island. The groin would intercept part of the littoral drift and supplement the impounding capacity of the jetty.

9. Approval of the above corrective measures was received and construction started on 10 December 1962 and completed on 23 June 1963 with the exception of the groin at Drakes Island. Strong objections were raised at a public hearing on the need and feasibility of the groin, and as a result, it was not constructed. In lieu of this groin, the north jetty was extended an additional 100 feet, or 200 feet in all, to a total length of 840 feet.

10. Dredging of the project began in July 1962 by hydraulic dredge with disposal on diked land spoil areas to provide the fill for an extensive public landing development. The owner of the dredging company was killed in an airplane accident immediately after start of the dredging operation (Aug. 1962), resulting in the loss of the principal managerial capability of the company. Numerous operational "bugs" beset the dredge, which was a new, "home-made" piece of equipment. Dredging was suspended during the period of December 1962 to March 1963 due to extreme weather conditions. Dredging resumed in March 1963 and progress was extremely slow. The contract was terminated in October 1963 as being in the mutual best interest of the Government and the contractor.

11. Subsequently, a second contract for dredging was awarded and work commenced on 10 August 1964. The contractor employed a 4 yard clamshell bucket dredge. This equipment worked at a very slow rate of progress and on 9 October 1964 sank during a storm. The contractor rented two small and one medium size hydraulic dredges to continue the work. By 31 January 1965 only a little over half of the original estimated quantity had been removed since commencement in August 1964, at which time the duration of the work had been estimated at two and one half months. Again, after some futile efforts by the contractor to establish a better contractual basis for resuming operations, this second dredging contract was terminated, effective 25 May 1965. At that time there remained about 25 percent of the original project dredging volume, or 58,000 cubic yards of material to be dredged, including pay overdepth, to

complete the harbor project. Of this amount, 18,000 cubic yards is in a bar with a controlling depth of 2 feet, extending about 400 feet in length, and crossing the outer channel at a point about 600 feet seaward of the outer end of the present jetties. The balance of the remaining volume is material that filled back in the inner harbor.

12. A major problem in both dredging contracts, in addition to the poor performance of the dredging equipment used, was the unexpectedly high rate of shoaling taking place, both in the entrance channel and in the inner harbor. Although efficient dredging operations could have completed the project in a relatively short time, the permanence of the channel and basin depths would be limited due to this rapid shoaling. The degree of satisfactory usability of the project would also be limited, and the maintenance costs to keep the project open would be high.

13. Local Cooperation Now Required. - The State and Town have been advised that, upon approval by the Chief of Engineers of the design of the presently proposed additional work, the State and Town will be required to furnish supplemental assurances of local cooperation. The requirements of local cooperation as listed in Paragraph 4 above would be exercised or modified as follows:

a. The supplemental assurances will not require any additional cash contribution, as the proposed work is to reduce Federal maintenance costs.

b. The present spoil area still has a capacity of 100,000 cubic yards of dredged material. As the presently proposed work entails dredging 210,000 cubic yards of material, 110,000 will be scowed to sea. Additional disposal areas will not be requested in view of strong objections by the U. S. Fish and Wildlife Service to any further destruction of marsh or flats in this area.

c. Both State and Town would specifically extend the "hold and save" guaranty to cover the proposed work.

d. Already satisfied - no further facilities required.

e. Already satisfied - no further diking required.

f. Already satisfied - no further alterations required.

14. Project Plan. - Consideration has been given to several methods of achieving a completed and stable navigation project. Careful evaluation has been made of a report by the Tidal Hydraulics Committee submitted in

January 1964 in response to request by the New England Division for advice on preventing excessive shoaling. Extensive field investigations and surveys including hydrographic, topographic and aerial, have been carried out at intervals to permit comparison of observations of the tendencies of the natural forces acting in the vicinity of the harbor. A model study was considered, but the estimated cost and time required (\$250,000 and three years) dictated against undertaking such a study. The Chief of Engineers by Indorsement dated 2 September 1964 approved a 3-year field study at an annual cost of \$20,000 to evaluate the problem and determine a further course of action.

15. Because of the urgency of the problem and the commitment to provide a completed, usable project now, in view of State and local contributions, the following proposed modification to the project plan is recommended at this time, to provide the desired small boat harbor as intended in the authorizing document. The effect of these modifications will be analyzed in the approved 3-year continuing field survey and study.

- a. Extend both jetties to 10-foot depth contour (about 1200 foot extension each jetty).
- b. Dredge settling basin in harbor, upriver of anchorage.
- c. Dredging of entrance channel and harbor as originally designed.

This supplemental work is shown on the map inclosed.

#### DESIGN

16. The basis of design length of the proposed jetty extensions is the report by the Tidal Hydraulics Committee, February 1964, that for the jetties to be reasonably effective, they should extend to the 10-foot depth. The jetties would be bent about 20 degrees, from their present direction about 40 degrees east of south to about 60 degrees east of south. As shown on the inclosed map, the points of bending would be 700 and 630 feet seaward of the present outer end of the north and south jetties respectively. This bending is to prevent direct wave entrance into the harbor from any particular storm direction.

17. The design of the jetty extensions is based on the following criteria and results in the following specific dimensions:

Mean high water  
Design tide

+8.7 feet  
+12 feet

	TRUNK	HEAD (100 feet)
Design wave	10 feet	14 feet
Top elevation	+16 mlw	+16 mlw
Top width	12(1)	12(1)
Slopes	1 on 1.5	1 on 2
Cover stone weight	5 Tons	10 Tons
Cover thickness	5 feet	10 feet
Under layer weight	1/2 Ton	1 Ton
Under layer thickness	4 feet	5 feet
Length (on top)		
North Jetty	1225 feet	
South Jetty	1300 feet	

- (1) Design width for 2 stones is 8 feet for trunk, and 10 feet for head. However, design is based on 12 foot top width, which is necessary for use of land construction equipment for economical and expeditious construction of the jetties.

18. The tides exceed average high water with the following frequencies.

Occurrences Per Year							
	+1 Foot		+2 Feet		+3 Feet		+3.5 Feet
Portland(1)	+10'	116	+11'	19	+12'	1	+12.5' 0.1
Portsmouth(1)	+9.7'	107	+10.7'	12	+11.7'	0.45	+12.2' 0.17
Wells(2)	+9.7'	116	+10.7'	19	+11.7'	1	+12.2' 0.17

(1) Recorded

(2) Interpolated from other two

The design tide approximates the maximum tide of record. With this tide, and a 50-mile per hour gale sustained for 8 hours, a 20-foot wave could be generated, but refraction would reduce this height to 14 feet at the outer end of the jetties. Hindcast studies for Penobscot Bay show 14 to 16 foot waves from NE to SE with a frequency of 176 hours per year. More representative wave heights are 10 to 12 feet from NE to SE with a frequency of 674 hours per year. The wave direction runs at an angle with the jetty alignment, never approaching directly normal to the jetty

face. This angle for most of the storms is less than 45 degrees. Therefore the wave height of 14 feet is estimated to be equal in effect to a wave height of 10 feet approaching normal to the jetty alignment. The ground elevation for the inner 1000 feet of each jetty extension is at or above mean low water, which would limit the maximum wave to a height of 10 feet.

19. A top elevation of 16 feet above mean low water for the trunk and also the head of the jetties has been selected. The jetties are 400 feet apart, and the jetty centerline is 150 feet from the near channel edge. Therefore wave overtopping can be allowed, and will happen during storms at maximum high tides with wave heights in excess of 4 feet. With a jetty top elevation 7.3 feet above mean high water, there should be little or no overtopping during normal weather or lesser storms. Construction and maintenance considerations are the principal basis for selection of the 16-foot top elevation. Normally in New England it has been found that jetty construction with land equipment working on the jetty itself is the more economical and faster method. This cannot be said always to be the case, as low bids have in certain instances been based on working with floating plant. It is considered probable on this project that land equipment would be used. This would require a width of 12 feet for trucks and 15 feet for cranes at the elevation considered safe and practicable for the equipment. Although various contractors might arrive at various decisions regarding a safe working elevation under the pressure of competitive bidding, it is considered that sound judgement, to reduce risks to a reasonable degree, would require crane operation at elevation of +11 feet mean low water. Trucks and bulldozers can operate, on the tide, at lower levels, and it is considered that they could readily operate at +9 mean low water (just about the normal high tide level) and for a short length of the outer jetty at +6 mean low water. The width necessary for safe operation of trucks and cranes is 15 feet, and for trucks passing cranes is 22 feet.

20. It is proposed to construct the jetties by pell-mell construction, truck dumping and spreading by bulldozer, except for the cover stone, which will be individually placed with the long axis normal to the jetty sloping face. With this construction, and side slopes of 1 on 1.5 for the jetty trunk, and 1 on 2 for the jetty head, the stone sizes are computed to be 5 tons and 10 tons respectively. One layer of cover stone so placed is considered sufficient for the jetty trunk, and two layers are required for the jetty head. This results in a thickness of cover stone of 5 feet on the trunk and 10 feet on the head. The underlayer, on the basis of 1/10th the weight of the cover stone, would be 0.5 ton stone on the trunk and one

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